CONTENTS

Page No.

CHAPTER- 1 INTRODUCTION TO MULTI LAYER CHIP INDUCTOR MATERIAL PROPERTIES 01-16

1.1 Introduction 01

1.2 Review of past work 03

1.3 Aim of the work 09

1.4 Measurement techniques employed 10

1.5 Thesis outline 11

References 12

CHAPTER-2 THEORETICAL BACKGROUND AND EXPERIMENTAL TECHNIQUES 17-39

2.1 Introduction 17

2.2 Ferrite Structure 17

2.3 Measuring techniques 19

a) X-ray diffractometer 19

b) Scanning electron microscopy 19

c) Field emission scanning electron microscopy 20

d) Transmission electron microscopy 20

e) Mossbauer spectroscopy 20

f) FT IR spectroscopy 21
g) Vibration Sample Magnetometer 21
h) Impedance analyzer 22
i) Two probe method 22
j) Archimedes principle 23
2.4 Theoretical background 23
A. Structural Properties 24
a) X-ray diffraction 24
b) Field emission scanning electron microscope 24
c) Mössbauer effect 25
i. Isomer shift 26
ii. Quadrupole interaction 27
iii.Magnetic hyperfine interaction 29
iv. Line shape and line width 31
d) Fourier transform infrared (FTIR) spectroscopy 31
B. Magnetic Properties 36
a) Saturation magnetization 36
b) Initial permeability 37
c) Curie temperature 38
References 39
Chapter 3 SYNTHESIS AND CHARACTERIZATION OF NICKEL ZINC FERRITE 40-65
3.1 a) Introduction 40
b) Selection of composition 41
c) Method of preparation 41
3.2 Results and discussion 42
a) Ferrite formation 42
b) Crystallite size 44
c) Particle size 46
3.3 High temperature heat treatment 51
3.4 Characterization 58
a) Agreement in d-values and lattice constant 58
b) Agreement in absorption bands from FTIR spectrum 59

c) Agreement in Curie temperature 60

References 62

Chapter 4 STRUCTURAL, ELECTRICAL AND MAGNETIC PROPERTIES OF Ni-Cu-Zn FERRITE PROCESSED WITH POLYETHYLENE GLYCOL AS CHELATING AGENT 64-89

4.1 a) Introduction 64

b) Method of preparation 64

4.2 Results and Discussion 65

Structural properties 65

A. X-Ray diffraction

a) Lattice constant 65

b) Crystallite size 67

B. Transmission electron microscopy

a) Particle size 69

C. Scanning electron microscopy

a) Grain size 71

D. FT IR Spectroscopy 73

Electrical properties

a) DC Resistivity 75

Magnetic Properties

a) Specific saturation magnetization and coercivity 77

b) Curie temperature 80

c) Initial permeability 81

d) Frequency dependence of initial permeability 83

e) Loss tangents and Q factors 84

Conclusions 87

References 89

Chapter 5 STRUCTURAL, ELECTRICAL AND MAGNETIC PROPERTIES OF Ni-Cu-Zn FERRITE PROCESSED WITH POLYETHYLENE GLYCOL AS CHELATING AGENT 90-137

5.1 a) Introduction 90

b) Method of preparation 90
5.2 Results and Discussion 91
Structural properties 91
A. X-Ray diffraction
a) Lattice constant 91
b) Crystallite size 92
B. Transmission electron microscopy
a) Particle size 95
C. Scanning electron microscopy 99
D. Field emission electron microscopy
a) Grain size 100
E. FT IR Spectroscopy 104
Electrical properties
a) DC Resistivity 107
Magnetic Properties
a) Specific saturation magnetization and coercivity 108
b) Curie temperature 111
c) Initial permeability 112
d) Frequency dependence of initial permeability 114
e) Loss tangents and Q factors 116
5.3 Cation distribution from Mossbauer data
a) Introduction 119
b) Experimental 119
c) Results and discussion 119
d) Assignment of sextets 122
e) Isomer shift 124
f) Quadrupole splitting and Hyperfine field 125
g) Calculation of X-ray intensities 132
h) Estimation of theoretical lattice constants 133
Outcome 135
References 136

Chapter 6

A) Conclusions and Future Suggestions 138
References 141